

# THE DONNELLY RIVER CATCHMENT: AN IMPORTANT REFUGE FOR ALL OF SOUTH-WESTERN AUSTRALIA'S ENDEMIC FRESHWATER FISHES AND THE POUCHED LAMPREY (*GEOTRIA AUSTRALIS*)

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## ABSTRACT

The fish fauna of the Donnelly River is described from historical published and unpublished data and from captures during 2006. The Donnelly River catchment is one of only two river systems that contain all of south-western Australia's eight endemic freshwater fish species. The high diversity of fishes in the Donnelly River catchment, including Lake Jasper, Lake Wilson and Lake Smith, is likely to be due to the heterogeneity of aquatic habitats in the system. For example, species such as the Salamanderfish and Black-stripe Minnow are restricted to ephemeral pools and floodplain environments on Scott Rd and around Lake Smith. Lake Smith is also the only known location within the catchment of the rare Balston's Pygmy Perch and, together with Lake Wilson, is the only known habitat in the catchment of the large Freshwater Cobbler. The Western Minnow, Western Pygmy Perch and Nightfish were relatively common and widespread through the catchment; occurring in most habitat types. The rare Western Mud Minnow is restricted to headwater streams and is very uncommon in the system, in part possibly due to predation by exotic species. It is also one of the few systems that provide extensive habitats for the adult and larval stages of the Pouched Lamprey. Three introduced fishes are known from the Donnelly River, the Eastern Mosquitofish, Redfin Perch and Rainbow Trout, the latter being the most widespread; presumably as a consequence of the long term stocking of the species into the catchment. Despite the presence of these introduced species, the Donnelly River should be considered of high conservation importance due to its south-western endemic fish populations.

## INTRODUCTION

The freshwater fish assemblage of the south-west of Western Australia (otherwise known as the Southwest Coast Drainage Division) has the highest proportion (80%) of endemic fishes in the country (Morgan *et al.* 1998). Of the 10 native freshwater fishes that are naturally found within the south-west, eight are found nowhere else.

The catchment of the Donnelly River is comparatively small, covering an area of approximately 1600 km<sup>2</sup>, with the headwaters arising ~60 km inland before flowing south-west where it discharges into the Southern Ocean (Hodgkin and Clarke 1989, Figure 1). Situated in the high rainfall belt in the south-western corner of Western Australia, the catchment is largely uncleared (80–90%) (Hodgkin and Clarke 1989, Pen 1999). Although there are ~20 river systems that are larger than the Donnelly River in south-western Australia, it is sixth in terms of mean annual discharge (310000 ML). Within the Donnelly River catchment are the near pristine wetlands of Lake Jasper, Lake Wilson and Lake Smith. Parts of the lower Donnelly River, Barlee Brook and much of Lake Jasper are of important cultural and archaeological significance and many of these sites are Registered Aboriginal Heritage Sites (Dortch and Godfrey 1990, Goode 2003, Goode and Irvine 2006).

The distributions of freshwater

fishes inhabiting the Donnelly River and the adjacent lakes were documented by Morgan *et al.* (1998), and include data from the collections in the Western Australian Museum and from those made by Christensen (1982) and from Jaensch (1992) in Lakes Jasper, Wilson and Smith. Hodgkin and Clarke (1989) provided a list of the fish species found within the Donnelly River Estuary and also included information on the catchment characteristics and physical features. Hoddell (2003) examined the phylogeny (i.e. evolutionary relationships) of the Western Hardyhead (*Leptatherina wallacei*) and the Swan River Goby (*Pseudogobius olorum*) in the lower estuary and Lake Jasper and compared these to populations elsewhere in south-western Australia.

Since the mid 1970s, a great deal of research has been conducted into biological aspects of the Pouched Lamprey (*Geotria australis*) with much of the work (almost 100 scientific publications) involving lampreys from the Donnelly River; sites of capture of adults and ammocoetes (larvae) being presented in Morgan *et al.* (1998). The Donnelly River is also regularly stocked with Rainbow Trout (*Oncorhynchus mykiss*) by the Department of Fisheries Western Australia and limited information on their diets are presented in Morgan *et al.* (2004).

By collating relevant information in the above studies and

through additional sampling for fishes in the lower Donnelly River, this study aims to provide an overview of the fishes in the Donnelly River and thus determine its conservation significance in terms of the highly endemic fish fauna of the region.

## METHODOLOGY

### FISH DISTRIBUTIONS IN THE DONNELLY RIVER

A number of studies provide information regarding specific aspects of the fishes of the

Donnelly River. Utilising GPS coordinates and species occurrences in Christensen (1982) (11 sites), Jaensch (1992) (three sites), Morgan *et al.* (1998) (24 sites) and Hoddell (2003) (three sites), with additional sampling of five sites during June 2006, we generated a series of species maps using *MapInfo* (MapInfo Corporation 1998) (see Figure 1). Information regarding species in the estuary was collated from Hodgkin and Clarke (1989), Hoddell (2003), Brearley (2005) and from samples obtained during June 2006 (this study).

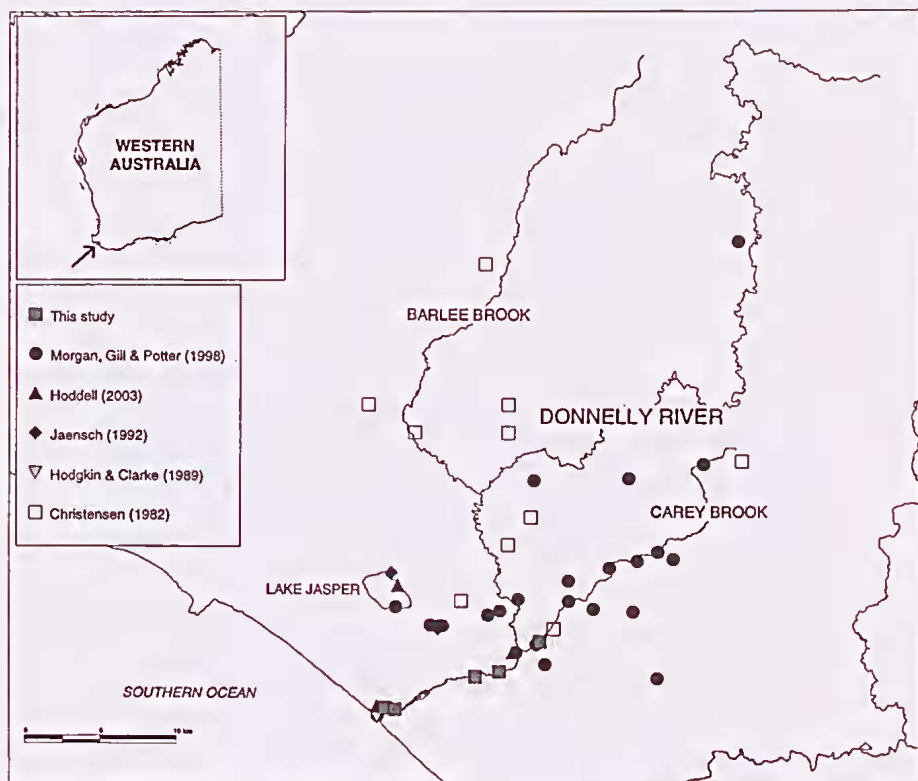


Figure 1. Sites sampled for fish in June 2006 and during relevant past studies; each of which was used to provide species distributions throughout the catchment.

Sampling that was undertaken during June 2006 included four sites within the estuary (tidal influence) and one site on Carey Brook (Figure 1). Sampling methods included monofilament gill nets, fine mesh (3 mm) seine nets, and both boat deployed (240v) and backpack (12v) electrofisher. At the time of sampling the river mouth was open and the river was tidally influenced to at least Boat Landing Road.

## RESULTS

In the following synopsis of the fish fauna of the Donnelly River, we have grouped species into a number of conventionally used life history categories, i.e. species have been grouped if they are strictly freshwater, estuarine or whether they are introduced fishes. A further category has been included to account for the anadromous Pouched Lamprey, which belongs to a primitive group of fishes known as the Agnatha.

### NATIVE FRESHWATER FISHES

The endemic freshwater fishes that are currently known to occur in the Donnelly River catchment include the Salamanderfish (*Lepidogalaxias salamandroides*), the Freshwater Cobbler (*Tandanus bostocki*), the Western Minnow (*Galaxias occidentalis*), the Black-stripe Minnow (*Galaxiella nigrostriata*), the Western Mud Minnow (*Galaxiella munda*), the Western

Pygmy Perch (*Edelia vittata*), Balston's Pygmy Perch (*Nannatherina balstoni*) and the Nightfish (*Bostockia porosa*).

The Salamanderfish is seldom found in the main channel, or even a major tributary, of any river system and the Donnelly is no exception. Within the Donnelly catchment the Salamanderfish has been captured from: the swamps surrounding Lake Smith, in pools along Scott Rd and on a large flat on Pneumonia Rd (Figure 2). Within the Donnelly catchment, the Freshwater Cobbler is only known from Lake Smith and Lake Wilson (Figure 3) (Jaensch 1992, Morgan *et al.* 1998). The Western Minnow is widespread throughout the Donnelly River and is also very abundant in Lakes Jasper, Wilson and Smith (Figure 4). However, the Western Mud Minnow and Black-stripe Minnow were far more restricted; the former being recorded at only three localities by Christensen (1982) (Figure 5), and the latter in a number of pools/floodwaters along Scott Road (Figure 6). The Western Pygmy Perch is widespread and relatively common in a number of habitats throughout the Donnelly River catchment (Figure 7). It is particularly abundant in Lake Smith and Lake Wilson. Balston's Pygmy Perch is extremely rare, and within the Donnelly River catchment is only known from Lake Smith, with one individual found in Fly Brook (Figure 8) (Morgan *et al.* 1998). The

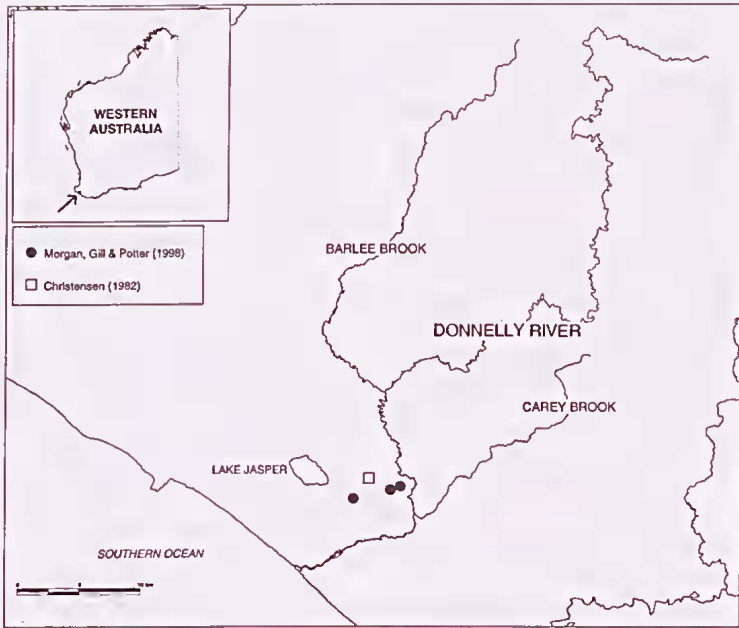


Figure 2. Capture sites of the Salamanderfish within the Donnelly River catchment.

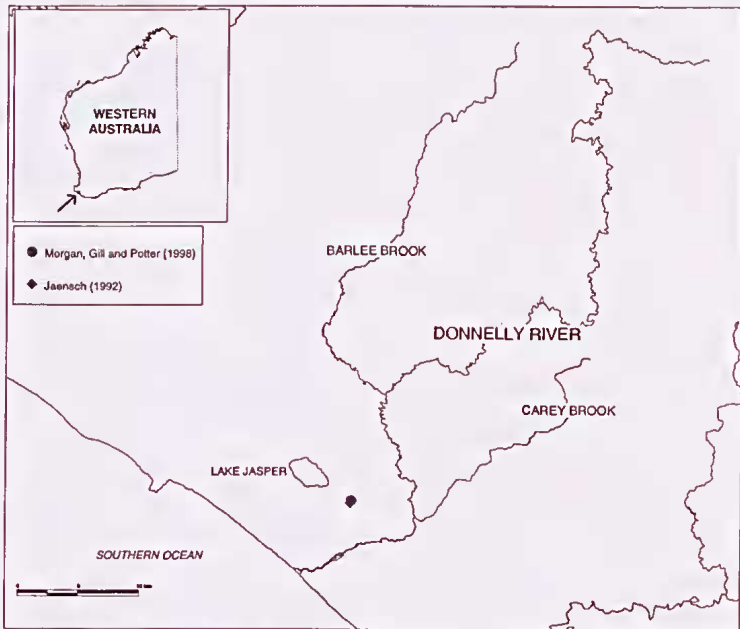


Figure 3. Capture sites of Freshwater Cobbler within the Donnelly River catchment.

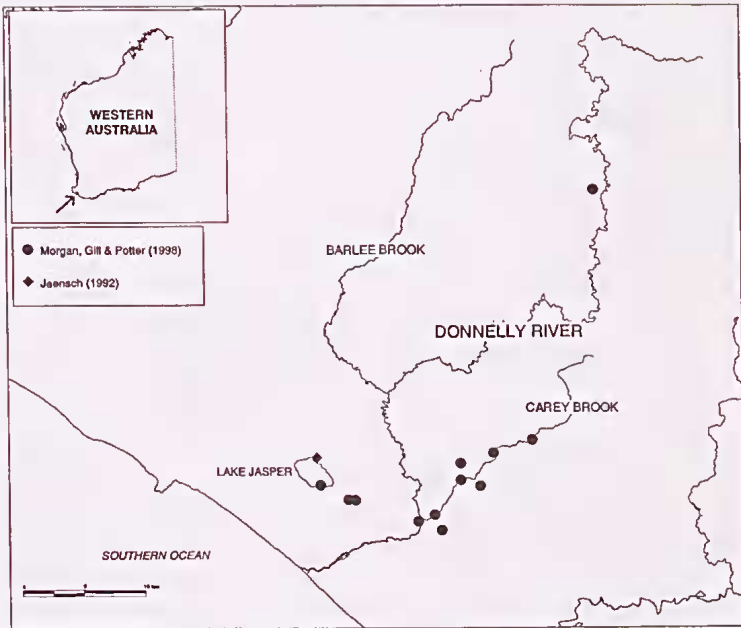


Figure 4. Capture sites of the Western Minnow within the Donnelly River catchment.

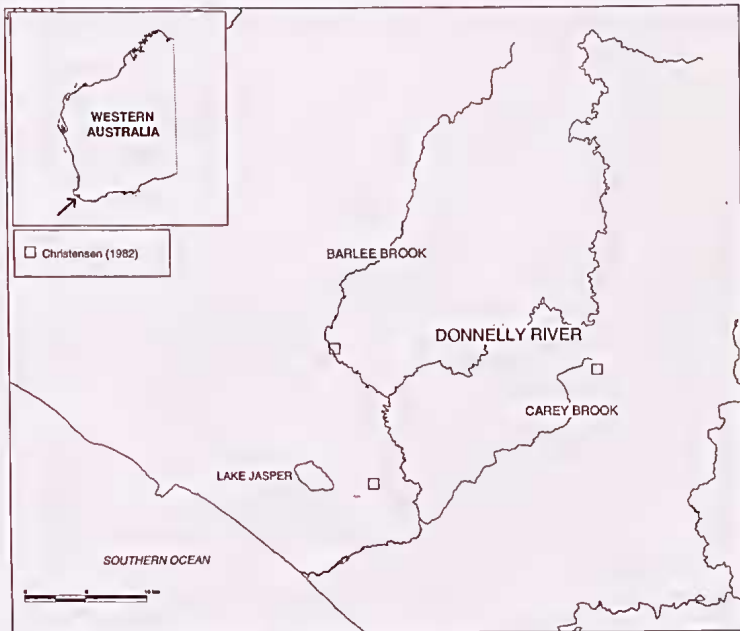


Figure 5. Capture sites of the Western Mud Minnow within the Donnelly River catchment.

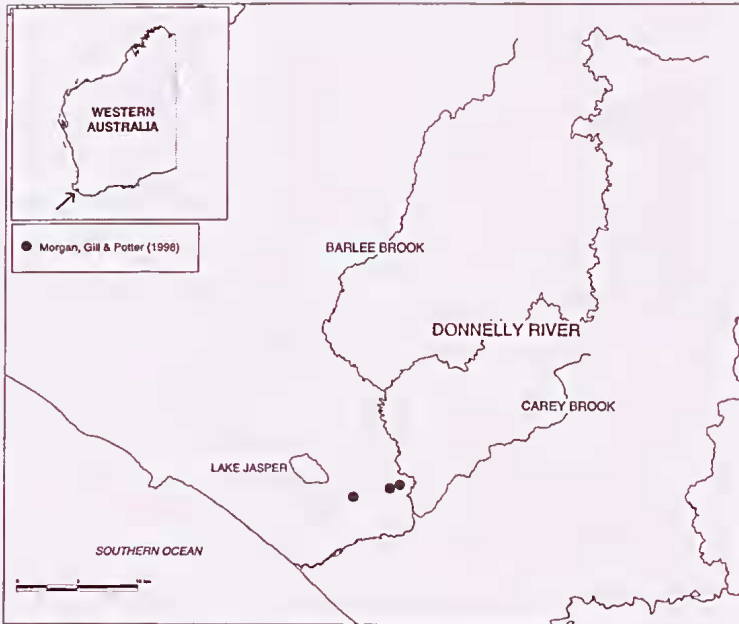


Figure 6. Capture sites of the Black-stripe Minnow within the Donnelly River catchment.

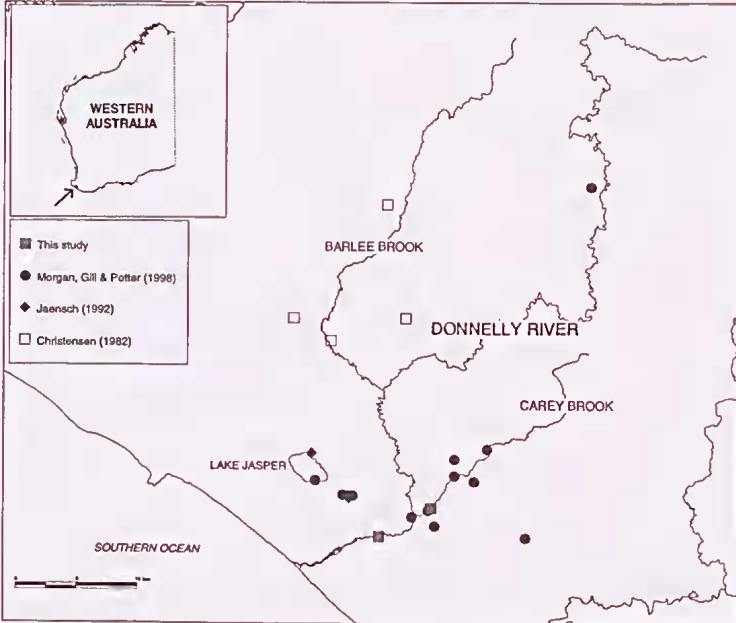


Figure 7. Capture sites of the Western Pygmy Perch within the Donnelly River catchment.

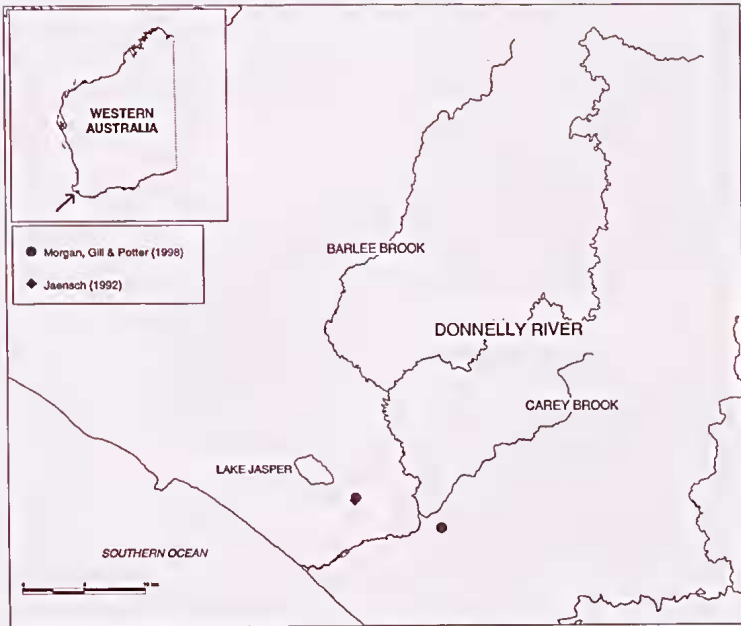


Figure 8. Capture sites of the Balston's Pygmy Perch within the Donnelly River catchment.

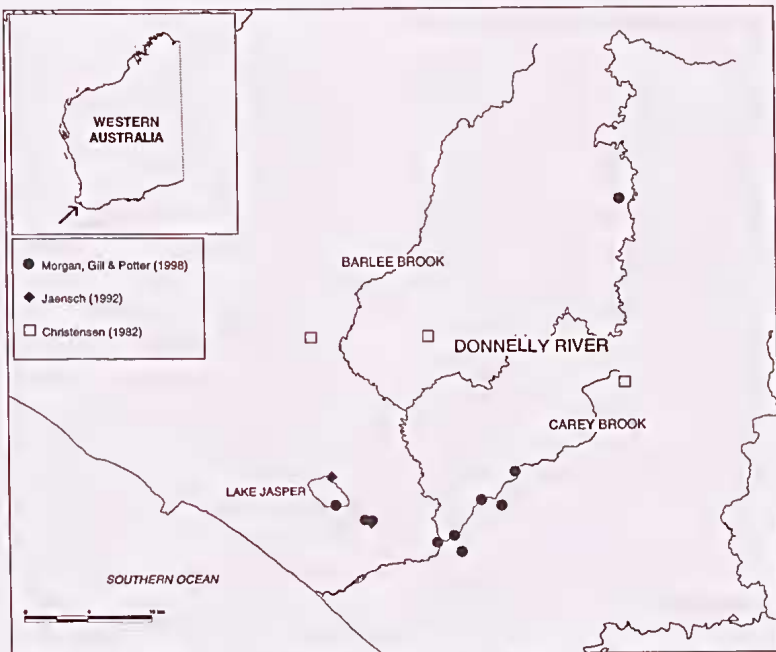


Figure 9. Capture sites of the Nightfish within the Donnelly River catchment.



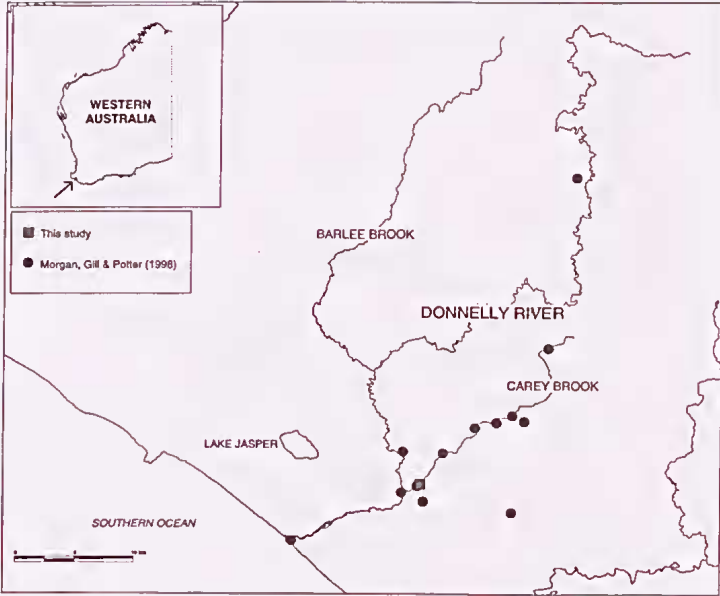


Figure 10. Capture sites of the Pouched Lamprey within the Donnelly River catchment. The site at the mouth and the upper river represents adults caught by colleagues at Murdoch University. Most other sites indicate ammocoete (larval) beds.

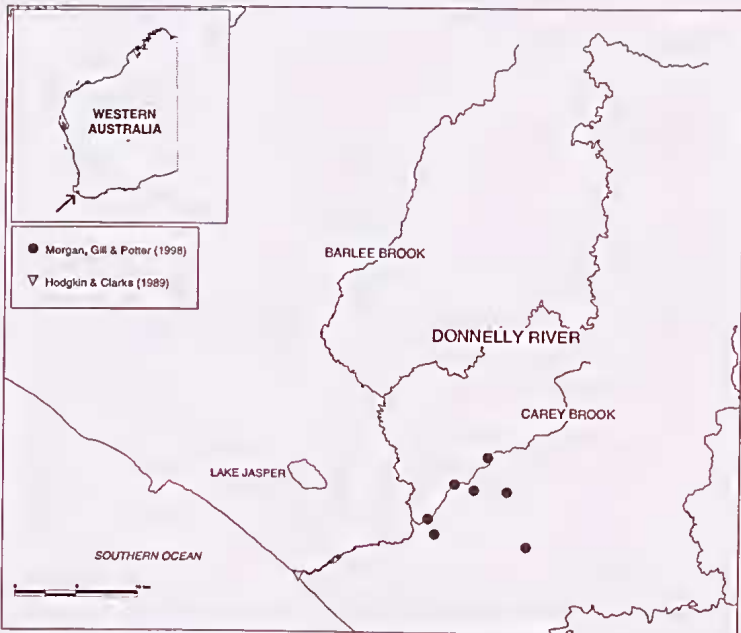


Figure 11. Capture sites of Rainbow Trout within the Donnelly River catchment.

Nightfish is found throughout the catchment including in the Lakes Jasper, Wilson and Smith (Figure 9).

#### *Pouched Lamprey*

Pouched Lamprey ammocoetes (i.e., larvae (see discussion for life-cycle)) were found at a number of sites within the Donnelly River (Figure 10). Furthermore, 92 downstream migrant staged Pouched Lampreys were recorded at Carey Brook during this study.

#### *Estuarine Fishes*

Our sampling in June 2006 in the estuary captured a number of estuarine species including Black Bream (*Acanthopagrus butcheri*), Tarwhine (*Rhabdosargus sarba*), Australian Herring (*Arripis georgianus*), Sea Mullet (*Mugil cephalus*), Yelloweye Mullet (*Aldrichetta forsteri*), Western Hardyhead (*Leptatherina wallacei*), Swan River Goby (*Pseudogobius olorum*) and South West Goby (*Afurcagobius suppositus*). During recent sampling we also captured the South West Goby in Carey Brook and the Swan River Goby was previously captured a considerable distance up the main channel of the Donnelly River (see Morgan *et al.* 1998). Hodgkin and Clarke (1989) report a number of marine/estuarine fishes from the Donnelly River estuary including: Black Bream, Yelloweye Mullet, Sea Mullet, Silverfish (*Atherinosoma presbyteroides*), Hardyhead (listed as Atherinid sp. but is presumably the Western Hardy-

head), South West Goby and Blue Spot or Swan River Goby. Brearley (2005) adds that other species, including Tarwhine, Cobbler (presumably *Cnidogobius macrocephalus*), Australian Herring and flathead sp. are also caught by recreational anglers in the river.

#### *Introduced Fishes*

The Donnelly River catchment has records of Eastern Mosquitofish (*Gambusia holbrooki*) and Redfin Perch (*Perca fluviatilis*) from a few locations (see Morgan *et al.* 1998) while Rainbow Trout (*Oncorhynchus mykiss*) are fairly prolific within the catchment (Figure 11).

## DISCUSSION

### NATIVE FRESHWATER FISHES

The Donnelly River catchment (including Lakes Jasper, Wilson and Smith) was found to house all eight endemic freshwater fishes of the South-western Australian Drainage Division. A number are known to be rare or restricted. The Salamanderfish has a very restricted distribution, occurring in pools from Augusta to just east of Walpole (Morgan *et al.* 1998). The species is characteristically found in tannin stained, acidic, ephemeral pools in heath land associated with the peat flats (Christensen 1982, Morgan *et al.* 1998). The Black-stripe Minnow is very restricted in geographical distribution and also in the habitat types that it occupies. Along with the

Salamanderfish, it is generally restricted to ephemeral pools along the south coast between Augusta and Walpole although disjunct populations have been recorded (Morgan *et al.* 1998, Morgan and Gill 2000). The Western Mud Minnow is one of the rarest of the south-west's endemic fishes having a fragmented distribution. For example, an isolated population of the species is found in the Moore River catchment near Gingin, the next nearest population being in the upper headwaters of Margaret River (Morgan *et al.* 1998). Specimens of the Balston's Pygmy Perch from Moore River are housed in the Western Australian Museum and Pen (1999) reports one individual from the Collie River. Its range has been severely fragmented by habitat change and they are now found from the upper reaches of Margaret River east to the Angove River.

More common endemic freshwater fishes were also recorded in the Donnelly River catchment. The Freshwater Cobbler has a relatively sporadic and unusual distribution within south-western Australia and is characteristically found in large waterbodies such as the main channel of rivers and/or dams. The Western Minnow is the most widespread and abundant of south-western Australia's endemic freshwater fishes and is known from the Arrowsmith River in the north to the Waychinnicup River in the

south-east. It is are found in larger rivers, small streams, lakes and floodwaters and have a diet that consists largely of terrestrial insects. The Lake Jasper population is infected with an introduced cestode (tapeworm), *Ligula intestinalis*. The Western Pygmy Perch is also widespread throughout south-western Australia, from the Arrowsmith River in the north to the Angove River in the south-east. The Nightfish is also comparatively widespread throughout south-western Australia from the Hill River to the Kalgan River. As with the Western Minnow, these latter two species are found in a wide range of freshwater habitats throughout their range (Morgan *et al.* 1998).

#### ESTUARINE FISHES IN THE DONNELLY RIVER

At the time of sampling the mouth of the river was open and the salinity of the bottom (at Hut 20) was 21.1 ppt while the surface salinity was 1.0 ppt. This salt-wedge was recorded as far upstream as the Boat Landing Rd boat ramp with bottom-water salinity being ~18 ppt with freshwater lying above. While the majority of the estuarine species recorded in the current study were not found beyond the lower estuary or limit of tidal influence, the Western Hardyhead, Swan River Goby and South West Goby are known to penetrate upstream into freshwaters in many of the south-west's rivers (Morgan *et al.* 1998).

Similarly, within the Donnelly catchment, they were all abundant within the freshwaters of Lake Jasper (Morgan *et al.* 1998).

#### POUCHED LAMPREY

The Pouched Lamprey belongs to the Petromyzontiformes, which are one of the only two surviving groups of the jawless (agnathan) stage in vertebrate evolution (Hardisty 1982). The absence of jaws and paired fins separates the agnathans from the cartilaginous (sharks and rays) and bony (teleosts) fishes. While there are 38 species of extant lampreys, the Pouched Lamprey is the sole member of the Geotriidae and one of only four species of Southern Hemisphere lampreys (Potter 1980). The species is known from south-western and south-eastern Australia, Tasmania, New Zealand and south-western and south-eastern South America (Potter 1996) and in WA it is found in most of the river systems from the Murray River south to approximately the Waychinnicup River east of Albany (Morgan *et al.* 1998).

The life-cycle is complex, with the worm-like larval stage (ammocoete) living in 'burrows' below the substrate where they feed on diatoms, detritus and micro-organisms. In south-western Australia at approximately four years of age (and at approximately 90 mm TL) the ammocoete undergoes metamorphosis with the resultant downstream migrant leaving the

river during winter. It is thought that there is a one to two year marine trophic phase, where it presumably feeds on fish and their length increases to approximately 500–700 mm TL. The adult then ceases feeding, re-enters rivers and embarks on an upstream migration (moving predominantly at night) during winter and spring. After spending approximately 15–16 months in the river, when they survive off accumulated fat reserves, the adults spawn and die. During this 15–16 month period in the river the adults mature and the males develop a large gular pouch (hence the name pouched lamprey). An enlargement of the oral disc also occurs during this maturation period.

The strength of the upstream migration of Pouched Lamprey is variable from year to year, and due to their nocturnal migration being in winter they are seldom seen. The sites where ammocoete Pouched Lamprey are found are generally characterised by a high degree of shade and a high abundance of organic material on the substrate; factors that are known to influence larval densities (Potter *et al.* 1986). However, the metamorphosed juveniles (downstream migrants) are most often associated with (buried in) sandy substrates that occur in well-oxygenated waters. The larvae are therefore particularly vulnerable to habitat modification as they rely on well oxygenated non-saline

waters that are characterised by shade and organic matter.

There is substantial evidence that lampreys are declining in numbers; particularly as a result of loss of suitable habitat for the larvae, and this is evident within south-western Australian rivers such as the Blackwood where salinisation and land clearing are causing loss of larval beds.

### INTRODUCED FISHES

Prior to 2005 a total of 10 species of introduced freshwater fish was recorded from Western Australia (Morgan *et al.* 2004), with a further two introduced fish species being captured in south-western Australia in the last two years. Approximately 500,000 Rainbow Trout fry were stocked by the Department of Fisheries Western Australia into the Donnelly River between 1999 and 2004, and this figure includes approximately 70,000 fry into both Carey Brook and Barlee Brook. This represents about 20% of all of the Rainbow Trout fry stocked into Western Australian waters. A further 20,500 yearling Rainbow Trout were also stocked during this period, representing ~13% of all yearling Rainbow Trout stocked. Although they are stocked into the freshwaters of the main channel and main tributaries of the system, Rainbow Trout are apparently commonly captured at the mouth of the river system at certain times of the year and were reported from the mouth

of the river by Hodgkin and Clarke (1989).

The impact of stocking a large predatory fish such as Rainbow Trout within the Donnelly River has not been assessed. An examination of the stomachs of 20 small Rainbow Trout (<310 mm TL, mean TL = 152 mm) in Carey Brook captured in May 1996 revealed that they preyed on a variety of fauna, but the stomachs were dominated by terrestrial fauna (insects) (35% by volume), freshwater crayfish (13%), dipteran larvae (11%), dipteran pupae (12%) and fish/larval lampreys (4%). The proportion of different prey eaten will no doubt change when considering larger trout (see Tay 2005). The impact of trout stocking in this system needs to be assessed in both the freshwaters and the estuary. The impacts of the other feral species that are found in the system are summarised in Morgan *et al.* (2004), while information on Redfin Perch and Eastern Mosquitofish in W.A. can also be found in Morgan *et al.* (2002) and Gill *et al.* (1999), respectively.

### CONCLUSION

The Donnelly River is one of the few systems in south-western Australia that continues to provide refuge for eight of the south-west's endemic fishes. As such, it should be considered important to the State's overall biodiversity. The fact that it also provides a major breeding

ground for the Pouched Lamprey adds to its conservation importance. The development of future management plans for the catchment should take into consideration the importance of this fish assemblage and incorporate them into any ecological monitoring programs. The protection and enhancement of instream and riparian habitat and water quality (particularly salinity levels) will ensure the ongoing sustainability of these populations.

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